VI. NOTES FROM THE BENGAL FISHERIES LABORATORY, INDIAN MUSEUM.

No. I.

By T. Southwell, *A.R.C.S. (Lond.), F.L.S., F.Z.S.,*
Deputy Director of Fisheries, Bengal.

(Plates vii—x.)

INTRODUCTION.

Dr. Linton in presenting his report on the Parasites of fishes of Beaufort, North Carolina, to the American Bureau of Fisheries (1) [1] made the following remarks :—

"To the naturalist no defence need be made for the time and energy spent in the study of life in any of its phenomena. To those who are not naturalists, however, some justification is due. Particularly does this become proper when the general public, by means of such laboratories as those of the Bureau of Fisheries, furnishes facilities for scientific enquiry. One who has never undertaken to get knowledge at first-hand from nature is likely to have little conception of the vast amount of work which is oftentimes necessary for the establishment of a very simple proposition. Suppose, for example, exact and complete information is desired as to the food of the English sparrow. It should not require much reflection to convince anyone that before an adequate answer can be made to such an inquiry, trustworthy observations must be made, by competent investigators, on the feeding habits of this bird, both adult and young, in different localities throughout the year, and through a series of years. But the general public may wish to know, and in this case has a right to know, what advantage there is to it in such scientific inquiry as is implied by an investigation made on the food and the parasites of fishes.

"It may, I think, be confessed that so far as may be seen while the investigations are in progress, much of the information which is collected will be of interest only to zoologists. In view, however, of the well-known fact that many diseased conditions, and even epidemics, result from the presence of parasites, and, further, that the parasites are as a rule introduced, either as eggs or larvæ, along with the food, it is not difficult to see that the more complete and systematic our knowledge becomes of the interrelations of the animals which harbour the parasite, interrelations which depend very intimately on the food habits of fishes, the more certain are we to be able to cope successfully with any disease which may arise. A case in point is furnished by one of the recent triumphs of medical knowledge. It is scarcely possible that the cause of malaria and of yellow fever could have been discovered if it had not been for the previous contributions to knowledge made by investigators in parasitism. The germ of malaria is a parasite whose round of life is passed in the blood-cells of man, and in certain organs of the mosquito. The germ of yellow fever seems to have a similar history. These interrelations between the mosquito and man were not even dreamed of a generation ago. The history of trichinosis is now so well known that a simple allusion to it in this connection is sufficient. Every well-informed

[1] These numbers refer to the literature cited at the end.

person knows, or may easily know, how the disease is communicated and what part is played in the matter by the pig and by rats and mice.

"The immense value to humanity of such a discovery as the cause of malaria and of yellow fever is entirely beyond our powers to estimate; and yet, this value must not be credited to this one discovery alone, as if it were a thing apart. No less credit must be given to the long line of investigators whose persistent interrogations of nature have led up to this discovery, and will surely lead to others no less valuable."

Linton's remarks apply very aptly to the situation of affairs in India. As our knowledge of the parasites of freshwater fish in India is at present nil, it is impossible to say to what extent the inland fisheries in particular are affected through this cause. As far as we know, there are no fish parasites in India capable of infecting man. In Europe, the larva of *Bothriocephalus latus* (a worm inhabiting man and often measuring 20 to 30 ft. in length) occurs in the Pike and is transmitted from this host to man; but up to the present this worm has not been recorded from India. It is just possible that a certain rare Trematode (*Gasterodiscus hominis*, Lewis and McConnel) recorded twice from man in Calcutta, may have its earlier stages either in the flesh or on the skin of certain fish. As far as we know at present, the bad effects of parasitism amongst fish are confined, in Bengal, entirely to the fish themselves, and amongst those forms inhabiting freshwater tanks these effects tend to be cumulative. An illustration will emphasize my meaning.

In the following paper is recorded a large larval worm (*Ligula simplicissima*) from the coelom of *Labeo calbasu*. This worm has its adult stages in a certain bird. Such birds live in the vicinity of the tanks containing the fish on which they feed. When a bird becomes infected, the parasite matures in the bird's intestine and passes millions of eggs to the exterior with the bird's faeces. Such faeces are often dropped in a tank and provide an extensive source of infection to the fish in the tank. The cumulative infection of the fish is due solely to the fact that such tanks have no current of running water. To what extent such infection exists in Indian fish has still to be determined. Infected fish are almost always thin, emaciated, undersized and lacking in vitality.

Of the Cestode parasites, the majority occur in the gut or on the mesenteries, and are thus removed before the fish is eaten. Up to the present no Cestode parasite, or cyst, has been recorded from the flesh of any fish in India. The Trematode parasites may occur either on the skin or in the gut, or, as in the case of the Mahseer recorded in this paper, the parasite may infect the muscles.

Of other causes resulting in the disease of fishes, such as parasitic Crustacea, Acanthocephala, Nematodes, infectious parasitic fungi, infectious parasitic Protozoa (Myxosporidia) and bacteria, India provides a new field of work, and at present it is impossible to say to what extent the inland fisheries suffer through the effects of such parasites.

ON SOME TREMATODE AND CESTODE PARASITES FROM FISH.

The only work done as yet on the parasites of Indian fish consist of the reports of :—

I. Shipley and Hornell who worked out the collection of Cestodes made by Prof. Herdman in Ceylon.

II. The present writer who continued and extended that work and described his own collections in the Ceylon Marine Biological Reports. (17).

III. Max Lühe who described the Trematodes collected by Prof. Herdman. (5).

These reports all deal with parasites from marine fish. The present paper is the first one dealing with parasites mostly from freshwater fish, either in India, Burma or Ceylon.

CESTODA.

The two species of Cestode parasites to be described, viz. *Ophryocotyle bengalensis*, n. sp., and *Bothriocephalus* (*Anchistrocephalus*) *polyptera* (Leyd) constitute the first record of any adult Cestode found in any Teleostean fish in Indian waters. Southwell in his examination of marine Teleosts in Ceylon over a period of five years never obtained a single adult Cestode parasite, although encysted larval forms were extremely common. The above two species were obtained from (*a*) *Ophiocephalus striatus* (Bengali, *Sol*) and (*b*) *Labeo rohita* (Bengali, *Rohu*). Both species of parasites occurred in each species of fish. Those from *Labeo rohita* were few in number. Those from *Ophiocephalus striatus* occurred in such large numbers, along with some undescribed Trematodes, that the lumen of the intestine of this fish in one particular case appeared entirely choked. Specimens of *Ophryocotyle bengalensis*, n. sp. were numerous. Only two specimens of *Bothriocephalus* (*Anchistrocephalus*) *polyptera* (Leyd.) were obtained. It has been noted that cystic forms of Cestoda in general are exceedingly common amongst marine Teleosts. On the other hand such cysts are quite rare in freshwater forms. Up to the present I have been unable to discover any except the larva of *Ligula simplicissima*, which will be referred to later, and this was not encysted, but free in the coelom. Contrary to what occurs in marine fish, adult Cestodes are fairly common in freshwater Teleosts in Bengal, and our examples were obtained from the first fish of the preceding species which we examined. This difference finds an explanation in the widely different conditions existing normally in the sea, and in fresh water. In the sea, adult Cestodes are always found in fish of the shark and ray tribe, which, on the whole, are not subject to the ravages of other predatory fish. In such an host the adult tapeworms find a safe and secure retreat, from which abode an unending stream of eggs are liberated.

The following list given by Linton will illustrate this fact:—

Cestode.	Usual or only known final host.	Intermediate hosts.
Tetrarhynchus bisulcatus ..	*Carcharhinus obscurus*	18 species of Woods Hole fishes.
		22 species of Beaufort fishes.
		2 species of Bermuda fishes.
Rhynchobothrium bulbifer ..	*Mustelus canis* ..	22 species of Woods Hole fishes.
Rhynchobothrium speciosum ..	*Carcharhinus obscurus*	12 species of Woods Hole fishes.
		3 species of Beaufort fishes.
		5 species of Bermuda fishes.
		4 species of Tortugas fishes.
Rhynchobothrium imparispine	*Raia ocellata* ..	28 species of Woods Hole fishes.
Otobothrium crenacolle ..	*Sphyrna zygæna* ..	In a large number of Woods Hole and Beaufort fishes, and in 3 Bermuda fishes; especially abundant in flesh of butterfish.

In fresh water, similarly suitable conditions for the parasite are found in Teleosts, as the larger forms of this group like *Labeo rohita*, and the voracious *Ophiocephalus striatus* (which occasionally attains a length of 3 feet or more), are seldom, if ever, preyed upon. There are only two species of freshwater rays known in India, viz. *Hypolophus sephen* (Mull. and Hen.) and *Trygon fluviatilis* (H.B.), measuring $5\frac{1}{2} \times 3\frac{1}{2}$ and $4\frac{1}{2} \times 2\frac{1}{2}$ feet respectively. These are not voracious, and it is improbable that either of them devour large Teleosts.

In the sea, Teleosts are frequently eaten by sharks and rays, and hence we find that Teleosts under these conditions harbour cystic forms only, and that these are capable of maturing and becoming adult in the intestines of their larger and more powerful enemies. In this connection it has already been pointed out (Southwell, 17) that marine Teleosts are not usually intermediate, but collateral hosts to the parasite, and this statement receives strong support from the conditions found to exist in freshwater Teleosts. The larval forms of the parasites to be described have not up to the present been found. It seems probable that they will eventually be discovered encysted either in certain Copepoda on which *Labeo rohita* feeds, or on the mesenteries of smaller fish such as are devoured by *Ophiocephalus striatus*.

The following list comprises, as far as I have been able to ascertain, all species of Cestodes which have been recorded from Teleosts. It is compiled from the works of Rudolphi (16), Lönnberg

(13), Riggenbach (15), Diesing (10), Lühe (14), Ward (18), Braun (9) and various papers by Linton. In some cases I have been unable to determine the authority for certain of the species of parasites named, and especially is this the case with those recorded by Diesing. The name placed in *square* brackets, after the specific name of the worm, indicates the source from which the record is derived. Those fish marked with an asterisk (*) are marine; those marked with a dagger (†) are freshwater forms, whilst those marked with a double dagger (‡) live partly in the sea, and partly in fresh water.

Parasite.		Host.
Sanguinicolle armata, Plehn.	[Lühe.]	† *Tinca tinca.*
,, *inermis*, Plehn.	,,	† *Cyprinus carpio.*
(Parasitic in the blood.)		
Caryophyllaeus mutabilis, Rudolphi.	[Lühe.]	† Cyprinoids generally.
Cyathocephalus truncata (Pall.)	,,	† ,, ,,
Leuckartia sp., Moniez.	[Ward.]	‡ Salmon.
Bothriocephalus proboscideus (Block.)	,,	‡ ,,
,, *solidus*, Drummond.	,,	‡ ,,
,, *succicus*, Lönn.	[Lönnberg.]	‡ *Salmo salar.*
,, *cordiceps*, Liedy.	[Ward.]	‡ Salmon.
,, *infundibuliformis*. Rudolphi.	,,	‡ ,,
,, *claviceps*, Rudolphi.	[Lühe.]	‡ *Anguilla anguilla.*
,, *carpionis.*	[Diesing.]	‡ *Salmo carpio.*
,, *criosis.*	,,	* *Salmo eriox.*
,, *barbatulae.*	,,	† *Cobitis barbatula*, Linnaeus.
,, *callariae*, Rudolphi.	,,	* *Gadus callarias*, Linnaeus.
,, *gadi rediani.*	,,	* *Gadus* (*Morrhua*) *minutus*. Cuvier.
,, *gadi morrhua*, Cuvier.	,,	* *Gadus morrhua.*
,, *lophii.*	,,	* *Lophius piscatorius*, Linnaeus.
,, *cepolae.*	,,	* *Cepola rubescens*, Linnaeus.
,, *bicolor*, Nordm.	,,	* *Pelamys sarda*, Cuvier.
,, *rectangulatum*, Rudolphi.	[Rudolphi.]	† *Cyprinus barbus.*
,, *fragilis*, Rudolphi.		‡ *Clupea alosa.*

Bothriocephalus punctatus, Rudolphi.	[Rudolphi.]	* *Cottus scorpio.*
,, (*Anchistrocephalus*) *polyptera* (Leyden).	[Southwell.]	† *Labeo rohita* and † *Ophiocephalus striatus.*
Dibothrium belones, Rudolphi.	[Diesing.]	* *Belones acus*, Cuvier.
,, *punctatum*, Risso.	,,	* *Rhombus barbatus.*
,, *crassiceps*, Cuvier	,,	* *Merluccius vulgaris.*
,, *rugosum*, Rudolphi.	,,	* ,, ,,
,, *plicatum*, Rudolphi.	,,	* *Xiphias gladius*, Linnaeus.
,, *heteropleurum*, Diesing.	,,	* *Centrolophus pompilus*, Lac.
,, *augustatum*, Rudolphi.	,,	* *Scorpæna scrofa*, Linnaeus.
,, *labracis.*	[Diesing.]	* *Labrax lupus*, Cuvier.
,, *manubriforme*, Linton.	[Linton.]	* *Tetrapturus imperator.*
,, *hastatum*, Linton.	,,	† *Polyodon spathula.*
,, *laciniatum*, Linton.	,,	* *Tarpon atlanticus.*
,, *occidentale*, Linton.	,,	* *Sebastodes.*
,, *restiforme*, Linton.	,,	* *Tylosurus carribaeus.*
,, *punctatum*, Linton.	,,	* *Platessa plana.*
,, *microcephalum*, Linton.	,,	* *Mola rotunda.*
,, *plicatum*, Linton.	,,	* *Xiphias gladius.*
,, *rugosum*, Linton.	,,	* *Gadus morrhua.*
,, *aluterae*, Linton.	,,	* *Alutera schoepfii.*
Taenia ocellata, Rudolphi.	[Braun.]	†‡* *Salmo*, *Perca*, *Acerina*, *Esox.*
,, *osculata*, Goeze.	[Diesing.]	† *Silurus glanis.*
,, *pollochii*, Ratke.	,,	* *Merlangus pollachius.*
,, *octolobata.*	[Rudolphi.]	* *Cottus norvegica.*
,, *filicollis*, Rudolphi.	,,	* *Cottus cernua.*
,, *calycina*, ,,	,,	† *Silurus glanis.*
,, *dilatata*, Linton.	[Linton.]	* *Anguilla chyrsopa.*
Ichthyotaenia diesingii, Monticelli.	[Riggenbach]	‡ *Silurus dargado.*

Ichthyotaenia macrocotyle, Monticelli.	[Riggenbach]	‡ *Silurus megacephalus.*
,, *coryphicephala*, Monticelli.	,,	† ,, sp.
,, *abscisca*, Riggenbach.	,,	,, ,,
,, *fossata*, Riggenbach.	,,	‡ *Pimelodus pati.*
,, *malapteruri*, Fitsch.	,,	† *Malapterurus electricus.*
,, *hemisphaerica*, Molin.	,,	‡ *Anguilla vulgaris.*
,, *salmonis omul*, Pallas.	,,	‡ *Salmo omul.*
,, *eperlani*, Acharius.	,,	* *Osmerus eperlanus.*
,, *idus*, Viborg.	,,	† *Leuciscus idus.*
,, *macrophalla*, Dies.	,,	† *Cichla monoculus.*
,, *belones*, Müller.	,,	* *Belone acus.*
,, *micropteri*, Liedy.	,,	† *Micropterus nigricans.*
,, *osculata* (Goeze).	[Lühe.]	† *Silurus glanis.*
,, *longicollis* (Rudolphi).	,,	‡ Salmonidea.
,, *torulosa* (Batsch).	,,	† Cyprinoids.
,, *percae* (Müll.)	,,	† *Perca*, etc.
,, *salmonis umblae*, Zschokke.	,,	‡ *Salmo salvelinus.*
,, *sagitta*, Grimm.	,,	† *Nemachilus barbatula.*
,, *ambigua* (Dujardin).	,,	† *Gasterosteus laevis.*
,, *cyclops*, Linstow.	,,	† *Coregonus maraena.*
,, *macrocephala*, Creplin.	,,	‡ *Anguilla anguilla.*
Bothriotaenia proboscidea, Mühling.	[Ward.]	‡ Salmon.
Ophryocotyle bengalensis, Southwell.	[Southwell.]	† *Labeo rohita* and † *Ophiocephalus striatus.*
Rhynchobothrium crassiceps, Diesing.	[Diesing.]	* *Lophius piscatorius*, Linnaeus.
Tetrarhynchus appendiculatus, Rudolphi.	[Ward.]	‡ Salmon.
,, *macrobothrius*, Von Siebold.		
Stenobothrium appendiculatum, Diesing.	[Ward.]	‡ ,,

Tetrarhynchus grossus, Rudolphi.	[Ward]	‡	Salmon.
,, *solidus*, Drummond.	,,	‡	,,
,, sp., McIntosh.	,,	‡	,,
,, sp., Creplin.	[Lühe.]	†	*Silurus glanis*.
Dibothriorhynchus gracilis.	[Diesing.]	*	*Ammodytes cicerelus*, Rafinesque.
Tetrabothriorhynchus migratorius, Diesing.	,,	*	*Belones acus*, Cuvier.
Tetrabothrium minimum, Linstow.	[Ward.]	‡	Salmon.
Monobothrium hexacotyle, Linton.	[Linton.]	†	*Catostomus* sp.
Ptychobothrium belones, Mihi.	[Lönnberg.]	*	*Belone vulgaris*.
Triaenophorus anguilla, Lönn.	,,	‡	*Anguilla* ,,

In addition to the preceding, the following parasites are probably adult in certain Teleosts, but I have been unable to verify this statement:—

Alyselminthus gasterostei, Zed.	*Taenia cyclops*, Linstow.
Bothriocephalus gadi barbati, Rudolphi.	,, *cyprini idi*, Rudolphi.
	,, *gasterostei*, Fabr.
,, ,, *merluccii*, Rudolphi.	,, ,, ,,
	,, *percae*, Müll.
,, *cyprini phoxini*, Leuckart.	,, *salmonis*, Müll.
	,, ,, *umblae*, Zschokke.
,, *salmonis carpionis*, Rudolphi.	,, ,, *wartmanni*, Fröl.
	,, *salvelina*, Schrk.
,, ,, *umblae*, Koll.	*Tetrabothrium polypteri*, Leydig.
,, *salvelina*, Lönnberg.	*Tetrarhynchus morrhuae*, Rudolphi.

The preceding list represents, I think, in a general way, all the adult Cestodes recorded to date from Teleosts. As far as I have been able to ascertain, I have excluded larval and immature forms from the list. In this respect I am by no means sure that this list is free from error, or that it includes absolutely *every* adult form recorded.

In all about a hundred species are recorded. As the total number of Cestodes known is probably well over 2000 species, the percentage recorded from Teleosts amounts to less than 5 per cent. of known species. It will be noted that very many of the Teleosts named, from which adult Cestodes have been obtained, are either marine, or spend some part of their life out at sea. Thus, salmon are marine fish which normally migrate up the rivers to spawn. The eels, on the other hand, are freshwater forms which migrate to the sea to spawn. In both cases it seems highly probable that the initial infection is brought about out at sea. This is certainly the case with the salmon. Excluding the migratory and marine species from the list, the number of Cestodes recorded from fish

which are purely freshwater forms is not more than 30, or approximately 1·5 per cent.

Specimens of the parasites described in this paper have been deposited in the Indian Museum.

Ophryocotyle bengalensis, sp. nov.

(Pl. vii, figs. 1—3.)

Over sixty specimens of this worm were obtained from the intestine of *Ophiocephalus striatus*, and a few were also obtained from the intestine of *Labeo rohita*. Both fish were caught at Berhampur Court, Bengal, in a freshwater tank. This genus of tapeworm usually occurs in birds, and considerable interest attaches to the presence of these adult forms in Teleosts. The average length of the worms was 7·5 mm. Greatest breadth (at posterior end) ·8 mm. These latter segments were from 4 to 5 times broader than long. The head consists of four cup-shaped suckers, directed slightly forward. Anteriorly the head terminates in an umbrella-shaped protrusible rostral disc whose circumference is armed with a large number of hooks arrranged in two rows. The exact number could not be determined, as, in removing the parasites from the intestine of the fish, many of the hooks had been torn away. The exact number counted in three specimens is given in the following table ;—

(i). One row of twenty-five hooks
(ii). Two rows with a total of fifty-three hooks.
(iii). Two rows with a total of fifty-two hooks.

The hooks appear to be all similar. They have broad bases and are sharply recurved in profile. Viewed end on they appear elongated (plate vii, fig. 3).

The suckers are armed with exceedingly minute spines which appear to be limited to their anterior borders. The head measures about ·5 mm. broad. The neck is fairly long, measuring 2·7 mm. Dots of black pigment are scattered about over the whole worm. The first proglottides are exceedingly shallow, and *all* proglottides are broader than long. The lateral margins are wrinkled in such a way that in young specimens the true strobilization can only be determined under a lens. The genital apertures are lateral and are almost all on one side.

The uterus appears to be made up of a number of rounded egg capsules scattered about the proglottid.

Habitat.—The intestines of *Labeo rohita* and *Ophiocephalus striatus*. Berhampur Court, Bengal, June 1912. About sixty specimens.

Amongst the worms just described were two large specimens measuring 27 mm. and 22 mm. respectively. They differ from the smaller forms only in having the neck very much shorter and in being much larger. Two rows of about 50 hooks were counted round the circumference of the rostral disc.

Bothriocephalus (Anchistrocephalus) polyptera (Leyd.).

(Pl. vii, figs. 4—6.)

Two specimens of this tapeworm were obtained. One was from *Ophiocephalus striatus* (Bengali, *Sol*) and the other from *Labeo rohita* (Bengali, *Rohu*). As far as I am aware it has hitherto been recorded only from *Polypterus bichar*.

Our largest worm measured 17 mm. long and the greatest breadth was ·8 mm. The head is rectangular in shape and consists of two fleshy bothridia united along their whole length, and deeply concave laterally, thus forming two sucker-like discs. The suckers vary slightly in size according to their degree of contraction. In the largest specimen the head measured 1 mm. long and ·45 mm. broad. Anteriorly it terminates in an umbrella-shaped sucker-like rostral disc, armed with about fifty-six spines around its circumference. The spines are fairly large and spindle-shaped, and are limited to a single row round the circumference of the rostral disc. These are arranged as in fig. 6. There is no neck. The anterior segment is overhung by the posterior edges of the bothridia. The first proglottid is almost square; succeeding proglottides broaden and become slightly shorter, so that the last segment is about five times as broad as long. The edges are markedly salient. The genitalia and excretory systems were not made out. Under high magnification the body was seen to be slightly pigmented, the pigment being distributed in the form of minute globular dots. Our specimens differ from the figure given by Braun (9) of this species, in the following points :—

	I. *Our specimens.*	II. *Braun's figure.*
(*a*)	Fifty-four spines round terminal disc.	Only thirty-two spines shown.
(*b*)	Spines spindle-shaped and straight.	Spines slightly sinuous.
(*c*)	Two spines, anterior and opposite to each lateral sucker.	Absent.

Only having two specimens, I have not thought it desirable to propose a new species on these minor differences. These variations may occur in this species. The occurrence of this worm in a Teleost is unique and has already been referred to.

Syndesmobothrium filicolle, Linton.

This parasite was obtained from a "Hilsa." As is well known, this fish (*Clupea ilisha*, Day) migrates from the sea up the principal rivers of Bengal in order to spawn. This takes place between August and October. One or more pterocercoid larvæ are frequently found on the mesenteries of each adult

fish. Such cysts have been obtained from Hilsa caught at Monghyr, Buxar, Calcutta and Diamond Harbour. The cysts are usually tadpole-shaped, but a few are strap-shaped. They vary extensively both in size and shape. The strap-shaped examples measured on an average 20 mm. long and 3 mm. broad. The tadpole-shaped cysts measured on an average 30 mm. long. The "head" of the cyst measured 3 mm. by 3 mm. and the rest of the cysts are 1·2 mm. broad. The larva itself is contained in the "head" of the cyst. This species appears to have a very wide distribution and was first described by Linton, who obtained it from a sting ray (*Trygon centrura*) in tropical America. The genus was founded by Diesing. Southwell also recorded it from Ceylon (17) as under:—

"I have no hesitation in referring to this species a number "of larval forms obtained from the intestines of *Cybium guttatum* "and *Chorenemus lysan*. The head of the larva is squarish in "front view, with a bothrium at each corner. The bothridia are "oval or cup-shaped. The larva agrees in every detail with "Linton's figure of this species, save that in our types the exit "of the proboscides were closed. The proboscis sacs were marked "with fine criss-cross lines only visible under a high power.

"*Habitat* I. The mesenteries of *Chorenemus lysan*.

"February 25th, 1911; 45 specimens.

"These larvæ were enclosed in tadpole-shaped cysts. The "cysts measuring on an average 25 mm. by 2·5 mm. The larva "was contained in the head part of the cyst which, in preserved "specimens, was of a yellow colour.

"The rest of the cyst was white, membranous and trans-"parent. The larvae measured 2 mm. by ·5 mm.

"II. The mesenteries of *Cybium guttatum*.

"November 27th, 1910.

"Fifty-five specimens; the same as the preceding. I believe "these specimens to be the same as those described by Shipley "and Hornell from *Cybium guttatum* in Part V of the Ceylon "Pearl Oyster Reports, plate iii, fig. 43. It is interesting to "note that Linton states that he has met with encysted forms "similar to this (*Syndesmobothrium filicolle*) in various species of "Teleostei, such as *Pomatomus saltatrix*, *Cybium regale*, etc. "He described one from Spanish Mackerel (*Cybium regale*) in "the 'American Naturalist' for February 1887, under the name "of *Tetrarhynchobothrium*.

"The occurrence of this larva in these Teleosts raises the "question as to the position of this stage in the life-history of "the parasite. On the whole I feel confident, and I have every "reason to believe, that the larvæ normally inhabit the tissues "of either crabs or molluscs, and have their adult stage in some "Elasmobranch. The presence of the larvae in these Teleosts is "due to their feeding on crabs or molluscs, but the larva does

" not develop any further in them than in crabs and molluscs. " But if either the fish containing these cysts derived from crabs " and molluscs, or the crabs and molluscs themselves, be eaten " by an Elasmobranch, then, in every case, the larva would attain " the adult form in the Elasmobranchs. The stage found in " these fish is probably not intermediate, but casual and accidental. " These fish are not to be regarded as intermediate but as " accidental hosts."

Rhynchobothrium sp. ?

A large number of club-shaped Cestode cysts were obtained from *Cybium guttatum*, Day, caught at Puri in January 1912. They measured 11 mm. long by 3 mm. broad. The smallest measured 6 mm. by 2 mm. This is the same species as that obtained and figured by Southwell from Ceylon waters (17) and from the same species of fish. The larva was also obtained in Ceylon from *Chorenemus lysan*, and was referred to as *Rhynchobothrium*, species I. The bothridia are two in number and are concave. Each bothridium appears to be divided by a faint longitudinal septum into two halves. At the posterior end, each bothridium is indented. The proboscides are coiled. The hooks are all similar and are long and slender, and bent suddenly almost at right angles at their extremity. Ninety-five specimens were collected from Ceylon in February 1911, eighty-six being from *Chorenemus lysan* and nine from *Cybium guttatum*.

Ligula simplicissima, Rudolphi.

(Pl. vii, figs. 7—8.)

Ligula simplicissima, Diesing.
,, *monogramma*, Creplin.
,, *digramma*, Creplin.
,, *catastoma*, Linton ?
,, *intestinalis*, Linnaeus.
Dibothrium ligula, Donnadieu.

Our examples were taken from the coelom of *Labeo calbasu* caught in a tank at Berhampur Court, Bengal, in September 1912. Five specimens were obtained having the following measurements :—

Specimen.	Length.	Breadth.
I.	22 mm.	8 mm.
II.	30 mm.	7 mm.
III.	43 mm.	10 mm.
IV.	145 mm.	8 mm

The largest specimen fragmented itself during preservation, but it measured over 320 mm. and its greatest breadth was 9·5 mm. These measurements refer to preserved specimens. The average

thickness was approximately 1 mm. This larva is very widely distributed in the coelom of fishes, particularly Cyprinoids. It becomes adult in from one to two days in the intestine of certain water birds, such as those of the genus *Sterna, Larus, Colymbus, Urinator*, etc., which normally devour infected fishes. The adult worm (*Ligula intestinalis*, Linnaeus) sometimes measures 1 metre long and from 5–15 mm. broad, and differs but little from the larval form.

In the Indian Museum there are the following specimens of this larva :—

I. One specimen from *Labeo rohita* (Bengali, *Rohu*), measuring 165 mm. long and 10 mm. broad.

II. One specimen from *Nemachilus rupicola* (Bengali, *Korika*), length 69 mm., breadth 5·5 mm., from a small mountain stream in the East Himalayas.

III. Three specimens with no history having the following measurements :—

(*a*) Length 147 mm. Breadth 9 mm.
(*b*) ,, 165 mm. ,, 10 mm.
(*c*) (Fragmented). Over 350 mm. long and 9 mm. broad.

The parasite is strap-shaped, and in our specimens the extremities vary considerably in appearance. In three specimens both the anterior and posterior extremities are deeply concave. In the remaining two, the posterior extremity tapers gradually to a rounded point, whilst the anterior extremity is broadly rounded with deep, acute, median indentation. The structure and anatomy of *Ligula catastoma* is described by Linton.

These larval Cestodes form articles of food in Italy where they are sold in the markets as "Maccaroni piatti," and in southern France where they are sold in the markets as "Ver blanc" and eaten extensively.

TREMATODA.

Isoparorchis, gen. nov.

Leaf-like and translucent worms, longer than broad. Oral and ventral suckers present, the latter being near the anterior extremity. Genital aperture almost midway between the two suckers. Each intestinal ramus in the form of a continuous letter **S** extending to the posterior margin of the worm. Testes in front of germarium, paired and globular, anterior, one on each side and very slightly posterior to ventral sucker. Vitelline glands dendritic and posterior. Germarium single, tubular and posterior. Uterus single, very long, disposed along the laterally directed loops of each ramus of the intestines, passing from one loop on one side to a loop on the other side alternately, across the body of the worm, to a point near the ventral sucker. It then runs straight in the median line to the genital aperture. Shell gland minute, situated at the junction of the uterus with the duct of the vitelline glands. Excretory pore terminal, median and posterior. Vesicle of varying size.

Excretory vessel bifurcating into two lateral branches a little anterior to vesicle, each branch running approximately parallel to the intestinal ramus on its own side. Parasitic in fishes.

Isoparorchis trisimilitubis, sp. nov.

(Pl. viii, figs. 9-11; and pl. ix, fig. 12.)

These Trematodes were first discovered infesting the air bladder of an adult specimen of the Silurid fish, *Wallago attu* (Bengali, *Boali*), caught in a freshwater tank at Bankipur, in March 1912. Since then, large numbers of specimens have been obtained, and every adult fish examined was found to be infected. Immature forms of this parasite have since been noted to occur in the flesh of the Mahseer (*Barbus tor*). Specimens of *Wallago attu* occur extensively in nearly all rivers of North and North-east India, and during the floods their larvae and fingerlings enter the tanks *viâ* the paddy fields. The fish is exceedingly voracious.

The following are the dimensions of a few of the parasites from *Wallago attu* :—

Specimen.	Length.	Breadth.
(*a*) ..	33 mm. ..	16 mm.
(*b*) ..	30 mm. ..	20 mm.
(*c*) ..	35 mm. ..	18 mm.
(*d*) ..	28 mm. ..	17 mm.
(*e*) ..	25 mm. ..	13 mm.
(*f*) ..	26 mm. ..	12 mm.
(*g*) ..	19 mm. ..	11 mm.
(*h*) ..	20 mm. ..	9 mm.
(*i*) ..	19 mm. ..	10 mm.
(*j*) [1] ..	10 mm. ..	4·5 mm.

The thickness of the largest worm was ·9 mm., that of the smallest ·2 mm. (approximately). The dimensions and thickness of the worms varied a little according to the degree of contraction.

The parasites were killed in an expanded condition by spreading two drops of spirit over the surface of the body. The worms in every case expanded. When fully expanded, they were plunged into 5 per cent formalin. For the determination of the anatomy, a few specimens were dehydrated, cleared in clove oil, and mounted whole. A few were stained with Delafields Haematoxylin, and others with Borax Carmine. I did not prepare sections, but made careful dissections of the genital organs.

External characters.—The parasites are leaf-like and of a deep flesh-colour, roughly oval in shape, the posterior margin

[1] The smallest specimen obtained.

being broadly rounded and the anterior extremity being produced into a rather long, thickened, acute projection with a rounded extremity. The thickening is apparently due to the presence of the cirrus sac. This projection shows a marked tendency to curve ventrally and assume a position at right angles to the body. The oral sucker is situated somewhat ventrally, at the extreme anterior. In the largest specimen (referred to as *c*) the diameter of the sucker was ·7 mm. In the same specimen the ventral sucker was situated 7 mm. from the anterior extremity and had a diameter of 1 mm. with extremely thick muscular walls. The genital aperture is situated midway between the oral and the ventral suckers and had a diameter of ·85 mm. The aperture of the excretory apparatus is situated posteriorly and is median. In mature specimens the testes can be seen as opaque milky-white globular bodies, 1 mm. in diameter, situated one on each side, and slightly posterior to the ventral sucker. The vitelline glands are conspicuous as darkish masses aggregated on the posterior dorsal surface and disposed principally round the posterior termination of the two rami of the gut. These two rami stand out prominently as a pair of black sinuous tubes having a diameter of 1 mm., and running from the anterior to the extreme posterior end of the worm, where they terminate blindly. They occupy a considerable part of the middle $\frac{2}{3}$rds of the length and breadth of the worm. The uterus is just visible as a delicate sinuous tube starting from the posterior end, running along the posterior laterally-directed loop of one ramus of the intestine, across to the laterally directed loop of the other ramus of the intestine, etc., to the genital aperture. Under magnification the tissue of the parasite presents a granular appearance.

Digestive system.—The mouth is situated at the base of the oral sucker and leads directly into a stout muscular pharynx. The oesophagus is exceedingly short and divides immediately into the two rami forming the intestine. Each branch runs at first straight towards the lateral margin of the worm and, rounding the ventral sucker laterally, runs ventrally to the posterior end in the form of a continuous letter **S**. The two rami do not lie symmetrically. The centrally directed loop of one ramus is situated opposite the laterally directed loop of the other ramus. The disposition of the coils of the uterus round these loops will be noted later. The two rami of the intestine extend to the extreme posterior extremity, where they terminate blindly, close to each other. The wall of the intestine is pigmented with very dark brown, almost black, and is minutely, annularly rugose throughout its length.

Excretory system.—Unless sections are made the gross details of this system cannot be made out, except perhaps in the living worm, and not always then.

The excretory aperture is situated at the posterior margin of the worm and is median. This aperture leads into a more or less globular or cylindrical contractile vesicle. From this vesicle the excretory duct runs forward a little distance and then bifurcates.

The two branches follow the contour of the two rami of the intestine, one on each side, to a point near the ventral sucker, beyond which they could not be traced. The inwardly directed loops of the branches of the excretory duct, however, extend much nearer the median line than do the corresponding loops of the intestine.

Reproductive system: (A) *Male.*—The testes are a pair of opaque globular bodies 1 mm. in diameter, situated one on each side of, and very slightly behind, the ventral sucker, and one testis is slightly anterior to the other. The efferent canals run forward towards the median line of the body where they appear to meet just in front of the ventral sucker. The vas deferens is short. The vesicula seminalis was not clearly made out. As sections were not prepared it was impossible to make out further details.

(B) *Female.*—The germarium is single and is situated posteriorly, and just anterior to the last inwardly directed loop of the right ramus of the intestine, and about 5 mm. from the posterior margin of the worm. It lies transversely as a sinuous tube. The uterus is a very long sinuous tube which first runs along the penultimate laterally directed loop of the right ramus of the intestine. It then runs across the body of the worm and along the penultimate laterally directed loop of the left ramus of the intestine. Then across the body again to the antepenultimate laterally directed loop of the right ramus of the intestine, etc., to the anterior, where it passes dorsal to the ventral sucker, to the genital aperture. The vitelline glands lie on the posterior dorsal surface. They consist of a large number of grape-like follicles connected to a duct which opens to the germarium close to the junction of the germarium with the shell gland. The shell gland is situated close to the junction of the vitelline duct with the uterus.

The recent advances made in parasitic zoology have resulted in the old genus *Distomum* having been split up into over eighty new genera. As far as I have been able to ascertain our specimens are not closely related to any of these genera.

A few specimens of this parasite were found in the flesh of a Mahseer (*Barbus tor*) caught by Capt. Parker, R.A.M.C., Sanitary Officer, Poona (Bombay Presidency), in April 1910, and were sent by him to the Indian Museum. The specimens were afterwards sent to Dr. Lieper of the Tropical School of Medicine, London. A single mounted specimen was retained in the Indian Museum and this I have examined. It measured 8 mm. in length, and the greatest breadth was 4 mm. It was immature.

Capt. Parker states that the parasite in the flesh of the Mahseer was surrounded with black pigment, and that the pigmented area extended to the surface of the skin, thereby suggesting that the parasites had bored their way in. As, however, these worms have no armature, this seems unlikely. Mahseer occur generally throughout India, but are found in greatest abundance, and of largest size, in mountain streams, or in streams which are rocky.

Wallago attu occurs throughout India, Ceylon and Burma. If Mahseer is a normal host of this parasite, then two hosts are now known. The host, or hosts, in which the earlier larval stages, sporocyst, redia and cercaria, occur, have still to be discovered.

Wallago attu is an exceedingly voracious fish and doubtless feeds amongst other species on *Nandus marmoratus*. It is possible that the mature Distomid described from *Wallago attu* may be the adult of the young Distomid described in this paper from *Nandus marmoratus*. The principal and only obvious differences lie in the fact that in the young form of this worm the gut is not sinuous, but this may become so when the parasite becomes adult. In that case the Mahseer (*Barbus tor*) becomes a collateral host only.

An immature Trematode from the ovaries of *Nandus marmoratus*, Ham. Buch.

"Distomum" sp.

(Pl. ix, figs. 13—14.)

During the examination of a number of specimens of *Nandus marmoratus*, Ham. Buch., a freshwater fish seldom exceeding 7 inches in length, from the Bhagirathi river at Berhampur Court, Bengal, India, on June 30th, 1912, large numbers of immature Trematodes were discovered parasitic in the ovaries.

No examples were found in the male fish examined, the parasites being limited entirely to the females. This fish spawns in the various rivers beyond tide-marks, between the middle of June and the middle of August. The diameter of the eggs is approximately ·5 mm. The parasites were found adherent by their ventral sucker to the eggs of the fish. Not more than one parasite was found attached to each egg, and roughly, not more than 10 per cent of the eggs were affected. The parasites were not easy to detect, being of exactly the same colour as the eggs of the fish, viz. yellowish brown. Other specimens of the parasite were found attached to the mesentery and to the stroma framework of the ovary. There can be no doubt but that such eggs as are attacked by this parasite are eventually destroyed, and it appears probable that the output of eggs is thus decreased by approximately 10 per cent. Infection appears to be highest when the eggs of the fish are almost ripe, and this serves the double purpose of providing a maximum of food for the parasite, as well as ensuring its protrusion and liberation with the ripe eggs. Opportunity is thus afforded the parasite of finding its final host and maturing therein.

Description of the parasite.

Length of the longest specimen	..	4 mm.
Length of the smallest specimen	..	2·8 mm.
Breadth of the longest specimen	..	1·3 mm.
Breadth of the smallest specimen	..	1 mm.

The body is superficially divided into two parts. The anterior $\frac{1}{5}$th is subglobular and the posterior $\frac{4}{5}$ths is flat and leaf-like. They

vary slightly accordingly to the degree of contraction during preservation. The ventral surface is slightly concave and the dorsal surface convex. The curvature is usually greatest towards the anterior extremity. At this extremity there is placed terminally, a slightly muscular sucker, ·4 mm. in diameter, at the base of which the mouth is situated. Owing to the curvature of the animal this sucker appears subventral rather than terminal. On the ventral surface, anteriorly, there is a second larger and more muscular sucker, having a diameter of ·6 to ·7 mm. and situated so that the centre of the sucker lies midway between the two superficial divisions of the body. Granular depositions occur in the skin. Anteriorly these are arranged in discontinuous concentric bands, whilst more posteriorly they become irregular, and are often concentrated at the lateral margins. The digestive apparatus represents all that is developed of the internal anatomy. As we have seen, the mouth is situated at the base of the anterior sucker. It leads into an extremely short oesophagus, and this divides immediately into the gut, which consists of two simple undivided branches running along the sides of the animal to the extreme posterior end. No pharynx was present. The two lateral branches, or rami, of the intestine are discernible to the naked eye, as broad thickened patches of a yellow colour, forming nearly the entire body of the animal. Under magnification, the walls of the intestine are seen to be puckered. Posteriorly, the two branches terminate blindly. No trace of either the reproductive or excretory system was discernible even under high magnification.

This species, which being immature, cannot at present be determined, bears a general resemblance to an immature *Distomum* obtained and figured by Linton (1) from two species of Dolphin, viz. *Coryphaena hippurus* and *Coryphaena equisctis*, common in American waters. He refers to this parasite (without naming it) as under:—

"Dimensions in millimeters, slightly compressed. Length 3·35. Diameter anterior 0·11, at ventral sucker 0·33, nearly uniform to posterior end. Oral sucker 0·10, breadth 0·08, ventral sucker circular 0·24 in diameter. These specimens are immature. There is no pharynx. The oesophagus is slender. The intestinal rami begin in a convoluted mass slightly in front of ventral sucker, and continue to the posterior end, being voluminous and apparently irregularly constricted, so as to present the appearance of a series of translucent bodies filling the post-acetabular region of the body. The intestines are filled with structureless seemingly colloid material. No trace of genitalia could be made out in any of these distomes. While they are immature there should be no difficulty experienced in recognizing these peculiar forms."

Our species thus differs from Linton's in being much broader and in having larger suckers. His were marine, ours are freshwater. Young forms of different species are, in all probability, very similar. It seems likely that in spite of the general resemblance of Linton's species to ours, they are different. The occurrence of

his specimens, however, in a Dolphin, which had fish in its stomach, seems to indicate that his form had been derived from fish, and that the worm had either not had time to develop in the Dolphin, or that it did not do so in that host. The condition described by Linton would find a parallel here in the stomach of any predaceous animal (such as *Wallago attu*) which might eat the eggs, or the mature female of *Nandus marmoratus*. The only other form, which, as far as I have been able to ascertain, resembles our species is a larva of *D. variegatum* figured by Dr. A. Looss (2). The differences between the two are that our specimens are twice as large, and that the ventral sucker is more anterior in ours than in that figured by Looss. Looss's examples were from the lung of a frog. The life-history of the worms constituting the genus to which our young specimens belong is extraordinarily complicated. Two examples briefly outlined will serve to indicate this fact and will also illustrate how difficult it is to determine young forms.

I. There occurs in Europe a Trematode belonging to the genus *Gasterostomum*. The eggs liberated from this worm have their first larval stages in certain mussels (*Anodonta*). In this host the larvae develop into sporocysts, and redia, and cercaria are eventually formed. If infected mussels are eaten by *Belone vulgaris* (a Gar fish) the cercaria develop into young Trematodes. *Belone vulgaris* has finally to be devoured by a Dogfish or Ray before the young worms become adult.

II. Again the disease known in Europe as liver-rot in sheep is caused by a worm (*Distomum hepaticum*) of the same genus as the larvae described from *Nandus marmoratus*. The eggs from the worm causing liver-rot are liberated with the faeces of the sheep, and these attack a small snail (*Limnea truncatula*). The earlier larval, sporocyst and redia stages are passed in the tissues of the snail. The resulting cercaria leave the snail and encyst on the grass. In this condition they are again eaten by sheep and the life cycle recommences. In the case of *Distomum hepaticum* the earlier larval, sporocyst, redia, and cercaria stages all develop in one host, whilst in the case of the *Gasterostomum* already cited, the preceding stages are distributed between two hosts, namely mussels and the Gar fish.

In the case of the young worms under consideration, the earlier larval, sporocyst, redia and cercaria stages have already been passed through. These stages, or part of them, are possibly passed in the snail *Vivipara bengalensis* which occurs abundantly along the banks of most rivers in Northern India. These must needs be eaten by the fish *Nandus marmoratus* before the young forms develop. The young worms are apparently liberated with the ripe eggs of the fish. These eggs are extensively devoured by frogs and voracious fish, and it seems likely that the adult worm occurs in such an host. A limited investigation of about 60 frogs found on the banks of the Bhagirathi yielded no result, and up to the present, other probable hosts have not been examined. Linton's young *Distomum*, referred to above, was apparently from

the stomach of the Dolphin, and the Dolphin had been feeding on fish as was shown by the stomach contents. The young form might not develop into an adult in the Dolphin, as nearly every parasite has its particular host.

Allocreadium annandalei, sp. nov.

(Pl. ix, figs. 15—16.)

A large number of specimens of this Trematode were obtained from the stomach of a specimen of *Rhynchobatis djeddensis* measuring 5 feet, caught in Portugal Bay, Ceylon, on February 2nd, 1911. The parasites were cylindrical in shape, slightly flattened dorso-ventrally and measured on an average 13 mm. in length (alcoholic specimens) and 3 mm. in breadth. The oral sucker is situated ·5 mm. from the anterior end and is subventral. The ventral sucker is situated 5·5 mm. from the anterior extremity and is raised above the general surface of the worm. The diameter of both suckers is 1·1 mm. and each sucker is very strongly developed. The genital aperture is situated nearer the oral than the ventral sucker, and is so minute that it cannot be seen except in sections. The excretory aperture is situated at the posterior extremity, which is pointed. The portion of the worm anterior to the oral sucker is flattened dorso-ventrally, and is also pointed. The external surface of the worm is marked by a series of both annular and discontinuous concentric rings.

Viewed *in toto*, cleared in clove oil, the edges of the worm appear serrated. No spines, however, are present, the spinose appearance being due entirely to the wrinkled cuticle. The muscular system is strongly developed, the thickness of the muscular wall of the body being ·3 mm. in spirit specimens.

Digestive system.—The mouth is situated at the base of the oral sucker, and leads directly into a strong muscular pharynx. The two rami of the intestine immediately succeed the pharynx and run laterally close up to the body-wall, to the extreme posterior end.

Reproductive system.—There are a pair of large testes, situated one in front of the other, at the extreme posterior end. They each measure roughly 1·4 mm. long and are squarish or oblong in shape and flattened dorso-ventrally. The vas deferens consists of a pair of extremely delicate tubes running laterally (one on each side) to a point just dorsal to the anterior rim of the ventral sucker, where they unite and open into the cirrus sac. This is large, muscular and conspicuous.

The cirrus is an irregularly coiled organ lying midway between the cirrus sac and the large seminal vesicle. The seminal vesicle abuts on the pharynx.

The ovary is single and is situated just in front of the testes in the middle line, 4·5 mm. from the posterior end. Between the ovary and the testes is the shell gland. The uterus is a coiled tube lying

between the ovary and the ventral sucker. Portions of the uterus extend forward on each side of, and dorsal to, the ventral sucker, and it eventually opens at the genital pore. The vitteline glands consist of a series of grape-like follicles, situated laterally between the ventral sucker and the extreme posterior end. The ducts connecting the follicles are clearly visible. In cross sections, the vitteline glands seem to be sunk in the muscular body-wall, and when this wall is removed the vitteline glands come away with it. The main ducts of the vitteline glands run transversely, one on each side, and, uniting in the middle line, open at the junction of the shell gland and the germarium, 4·4 mm. from the posterior extremity of the worm.

Excretory system.—As sections were not made, no details of this system could be made out.

Habitat.—The stomach of *Rhynchobatis djeddensis*. Sixty-seven specimens. Pearl Banks, Ceylon. February 2nd, 1911.

This species appears to fall naturally into the genus *Allocreadium*, Looss, of which the type species is *Distomum isoporum*, Looss. I have pleasure in naming my specimens in honour of Dr. Annandale, Superintendent of the Indian Museum.

PROVISIONAL DESCRIPTION OF A NEW GENUS AND SPECIES OF TREMATODE.

Cylindrorchis, gen. nov.

Body cylindrical. Oral and ventral suckers present, the latter being situated near the anterior extremity. Genital pore minute and situated immediately posterior to oral sucker. Intestinal rami in form of a continuous letter **S** and extending to the posterior end. Testes in front of germarium. The former are paired, cylindrical, thick, conspicuous, bent in the form of the letter **S**. They extend, one on each side, from the anterior margin of the ventral sucker to a point one-third the length of the worm from the posterior end. Germarium and shell gland single, median, and situated immediately behind posterior limit of testes. Uterus coiled and lying for the most part behind the germarium. Vitelline glands aggregated into two main masses, lateral to the germarium, and situated on the loop of the intestine, one mass on each side. Excretory pore median, terminal, posterior.

The character of the testes indicates that this genus has no close relationship with any other known genera.

Parasitic in fishes.

Cylindrorchis tenuicutis, sp. nov.

(Pl. x, figs. 17—18.)

During the examination of a number of specimens of *Tetrodon stellatus*, caught on the Ceylon Pearl Banks in 1911, a few Trematodes were found in the air-bladder. In every case where these Trematodes were obtained, the air-bladder was found to be full of a

black shiny substance having the consistency of wet clay. It is possible that this substance represents decomposed blood, the exudation of blood into the air-bladder being caused by the sucking action of the parasite. Unfortunately a sample was not kept for examination. The parasites lay embedded in this mass and measured 16 mm. long and 5·5 mm. broad. In shape they were cylindrical. The oral sucker is terminal and subventral. The ventral sucker is situated 3·5 mm. from the anterior extremity. Both suckers have a diameter of ·8 mm., and are but feebly developed. The most remarkable feature of this parasite is the almost entire absence of muscles from the body-wall, the various organs being encased in an exceedingly thin diaphanous transparent cuticle. This circumstance is to be correlated with the habits of the parasite, living as it does in a medium where movement is well nigh impossible. The mouth is situated at the base of the oral sucker. This leads directly into a muscular pharynx. The oesophagus is very short. The two rami of the intestine are large sinuous tubes having a diameter of 1·1 mm. and being usually filled with a dark brown material apparently derived from the medium in which they live. Both rami of the intestine run to the extreme posterior end, where they terminate blindly.

As only a very few specimens of the parasite were obtained, it was found impossible to satisfactorily make out, with *certainty*, the precise details of the reproductive system. I am therefore not certain that the following description is absolutely correct in every detail.

The genital pore is minute and is situated ventrally, immediately posterior to the oral sucker.

The testes are a pair of very large, sinuous, cylindrical bodies situated one on each side, and extending to a point about 6 mm. from the posterior extremity. Anteriorly, each gives off a vas deferens, and these unite in the middle line. The cirrus is bent upon itself. The main mass of the vitteline glands is aggregated over a loop of the intestine, one mass on each side, immediately behind the termination of the testes. The main ducts run transversely, towards the median line, and open at the junction of the ovary and shell gland. These latter organs are situated close together, in the middle line, about 5 mm. from the posterior extremity, the shell gland being posterior to the ovary. The uterus is a coiled tube. For the first part of its length it lies posterior to the ovary, and then runs forward, sinuously, in the middle line (anterior to the ovary) to the genital pore.

The excretory pore is terminal, but no details of this system could be made out.

"Distomum" sp. ?

(Pl. x, fig. 19.)

Four specimens of an immature species of "*Distomum*" were obtained from the intestine of *Ophiocephalus striatus*, the same

specimen of fish in which were found specimens of *Ophryocotyle bengalensis*, n. sp. and *Bothriocephalus* (*Anchistrocephalus*) *polyptera* (Leyd.). They measured 9 mm. long and were club-shaped. The breadth at the posterior is 2·5 mm. and at the anterior extremity 1 mm. The oral sucker is ·6 mm. in diameter. The ventral sucker is situated 4 mm. from the anterior extremity and has a diameter of ·85 mm. The pharynx is small and no oesophagus is present. The two rami of the intestine are sinuous, terminating blindly at the posterior extremity. The inwardly directed loop of one ramus of the intestine is situated opposite to the laterally directed loop of the other ramus. Reproductive organs were not developed. It is impossible at present to identify this immature form, but it bears a strong resemblance to the immature form of *Isoparorchis trisimilitubis*, n. sp., obtained from the muscles of the Mahseer (*Barbus tor*) and already described.

Anaporrhutum largum, Lühe. (5)

This Trematode was first obtained by Prof. Herdman in Ceylon from the coelom of *Rhinoptera javanica*. He only obtained a single specimen. Large numbers of this species have since been obtained by Southwell in Ceylon, from the coelom of *Chiloscyllium indicum*, *Ginglymostoma concolor* and *Aetobatis narinari*.

A species of *Anaporrhutum* was also obtained by Dr. Jenkins from the coelom of *Stegostoma tigrina*, caught off the Orissa coast on December 15th, 1910.

It differed from the Ceylon specimens of this species in the following points:—

Orissa specimens.	*Ceylon specimens.*
(*a*) Leaf-like in outline.	(*a*) More circular in outline.
(*b*) Internal wall of the gut thrown into steep ridges.	(*b*) Ridges not well marked.

Besides the preceding points the testes and vitteline glands in the specimens collected by Dr. Jenkins were but feebly developed. At first, this seemed a striking difference, but I am inclined to think that the species are the same in spite of the differences named.

The three species of *Anaporrhutum*, viz. *A. largum*, *A. albidum* and *A. richiardii*, appear to be widely distributed amongst Elasmobranchs in Indian waters.

Anaporrhutum albidum, Ofenh.

Large numbers of this Trematode were obtained in 1911 from the surface of the liver of a *Chiloscyllium indicum*, caught on the Ceylon Pearl Banks. They differed from Ofenheim's description and figure (7) in (i) having the ventral sucker much larger than in Ofenheim's specimens and (ii) in having the testes less scattered. This latter fact may, however, be due to the testes not being

fully developed in our specimens. Ofenheim's specimens were from *Aetobatis narinari*.

Anaporrhutum richiardii, Lopez. (7).

About six specimens of this Trematode were obtained from the surface of the liver of *Aetobatis narinari*, caught on the Ceylon Pearl Banks in 1911.

Cricocephalus resectus, Looss. (3).

Three specimens of this Trematode were obtained from the intestine of the land tortoise, *Testudo elegans*, caught in Ceylon in 1911. Although this parasite was obtained from a tortoise, and not from a fish, the opportunity is here taken of recording it.

LIST OF LITERATURE CITED.

A. *Trematodes.*

1. Linton, Edwin .. Parasites of fishes of Beaufort, North Carolina. *U.S. Bulletin of the Bureau of Fisheries*, vol. xxiv, 1904.
2. Looss, A. .. Die Distomen Unserer Fische und Frosche. In *Bibliotheca Zoologica.* (Leuckart and Chun) vol. vi, 1894—95.
3. ,, .. Ueber neue und bekannte Trematoden aus Seeschildkroten. *Zool. Jahrb. Syst. Abth.*, vol. xvi, 1902.
4. Lühe, Max .. *Die Susswasserfauna Deutschland*, Heft 17, Trematodes, 1909.
5. ,, ,, .. Trematode Parasites. *Ceylon Pearl Oyster Reports*, part v, 1906.
6. Odhner, Theodor .. Die Trematoden des arktischen Gebietes. *Fauna Arctica*, vol. iv, 1905—06.
7. Ofenheim, E. von .. Ueber eine neue Distomidengattung. *Zeit. fur Nat.*, vol. 73, 1900—01.
8. Olsson, P. .. Bidrag till Skandinaviens Helminthfauna. *Vetenskaps Akademiens Handlinger*, vol. xxv, part ii, 1893—94.

B. *Cestodes.*

9. Braun, M. .. In *Bronn's Thier-Reichs*, Cestodes, 1894—1900.
10. Diesing, C. M. .. Systema Helminthum, 1851.
11. Linton, Edwin .. On two species of larval *Dibothria* from the Yellowstone National Park. *Bulletin U.S. Fish Commission*, vol. ix, 1899.

12. Lönnberg, E. .. Anatomische Studien der Skandinavischen Cestoden. *Vetenskaps Akademiens Handlingar*, vol. xxiv, parts i and ii, 1890—1891.

13. ,, ,, .. *Bihang till K. Sv. Vet. Akad. Handl.* Band 14. Afd. iv. No. 9. Stockholm, 1889.

14. Lühe, Max .. *Die Susswasserfauna Deutschlands*, Heft 18, Cestodes, 1910.

15. Riggenbach, E. .. Das genus *Ichthyotaenia*. *Revue Suisse de Zoologie*, Bd. iv, 1896—97.

16. Rudolphi, C. A. .. Entozoorum sive vermium intestinalium historia naturalis, vol. ii, parts i and ii. Amstelaedami, 1809—1810.

17. Southwell, T. .. *Ceylon Marine Biological Reports*, parts v and vi, 1910—11.

18. Ward, H. B. .. Internal parasites of the Sebago Salmon. *Bull. Bureau Fisheries, Washington*, vol. xxviii, 1908.